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FIVE ORIENTAL SPECIES OF BEANS.

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INTRODUCTION.

Among the food plants of secondary importance in different parts of Asia are five annual species of beans that at various times have been introduced into the United States but concerning which very little definite information has been published. These five are the adsuki bean (*Phaseolus angularis*), the rice bean (*Phaseolus calcaratus*), the mung bean (*Phaseolus aureus*), the urd (*Phaseolus mungo*), and the moth bean (*Phaseolus aconitifolius*). Unfortunately, there has been considerable confusion in the literature, both botanical and agricultural, concerning these beans, especially between the first two and between the third and fourth. The adsuki bean has even been confused with the very different urd.

The illustrations in this paper well show the peculiarities of each of these five species. They may also be distinguished by the following key (compare Pl. VII):

Leaflets parted into 3 to 5 narrow lobes..... *Moth.*
Leaflets entire or occasionally 2 or 3 lobed.
  Plants and pods very hairy; seeds mostly dull.
    Pods with short hairs; seeds globose or subglobose, green, rarely brown, blackish or yellow, the testa marked with fine crenulate lines; hilum not concave..... *Mung.*
    Pods with long hairs; seeds oblong, blackish, the testa not crenulate striate; hilum concave..... *Urd.*
  Plants smooth or little hairy; seeds smooth and shiny.
    Pods constricted between the seeds; hilum not concave..... *Adsuki.*
    Pods not constricted between the seeds; hilum concave..... *Rice.*

The five species of Phaseolus considered in this bulletin were, together with others, placed by De Candolle (1825, p. 394–395)[1]

[1] For complete bibliographic references, see the alphabetical list of literature cited at the end of this bulletin.

and by Bentham (1840, p. 139) in the subgenus Strophostyles. Strophostyles Elliott is based on the American plant called *Phaseolus umbellatus* by Muhlenberg. American botanists generally consider Strophostyles a valid genus, differing from Phaseolus in having the keel curved but not spiral. The two keel petals are inflated near the middle in the broadest part and each has a semicircular expansion on the dorsal edge. The stigma is terminal; that is, there is no appendage at the tip as in Phaseolus. The pods and seeds of Strophostyles are much like those of the mung and related species, and it was apparently on these characters that Bentham associated the two. The keel and stigma characters of Strophostyles, however, indicate that there is no such close relationship.

The five species possess the following characters in common: Plants annual; stipules with a basal appendage; flowers yellow; keel spirally coiled, bearing on one side a hornlike appendage; style hairy, prolonged into a narrow appendage beyond the stigma; stigma lateral, subterminal; pods linear, subterete, sometimes torulose; seeds globose to oblong; hilum narrow, linear. The style and stigma characters of the adsuki are like those of the kidney bean (*Phaseolus vulgaris*) in that the terminal appendage is flattened, while in the other four species it is terete. This difference is apparently not significant, except as showing that these species truly belong with Phaseolus. The other characters, however, seem sufficient to warrant the recognition of a subgenus for the mung and its allies, which may be called Ceratotropis, from the Greek words signifying *horn* and *keel*.

The mung bean is cultivated more or less extensively in all parts of Asia where it will mature and also in southeast Africa, where it was probably carried by Hindoo traders. The urd and the moth bean are cultivated only in India. The adsuki is confined to Japan, Manchuria, China, and Chosen (Korea), unless a similar bean in Nepal and Sikkim is identical. The rice bean is most frequently seen in China and India, but it is also cultivated in Japan and the Philippines.

Presumably the cultivation of all of these was relatively more important previous to the discovery of America, which led to the general dissemination of the kidney bean and the Lima bean, both of which are now largely cultivated in all the regions mentioned. Nevertheless, the five oriental species are still of considerable agricultural importance and doubtless will always be cultivated. All of them have been rather extensively tested from the standpoint of forage and of green-manure crops in the United States, especially during the past six years, but it seems doubtful whether any of them can compete in these respects with the cowpea and the soy bean. As producers of seed for both human food and animal food, however, there are possibilities in these crops well worthy of much further investigation. Their final position in American agriculture

FULL-GROWN PODS AND A BRANCH WITH LEAVES AND FLOWERS OF THE ADSUKI BEAN.

will perhaps depend more on their acceptability as human food than on their value for other purposes.

The adaptations of these five species of beans are very similar to those of the cowpea, all requiring hot summer weather for their satisfactory development. The varieties of the mung and the urd are fairly numerous; some early, others late. The moth has but few varieties and all are rather late, so they will not mature as far north as Virginia. The adsuki produces numerous early varieties and some of these will probably ripen wherever the common bean will mature. Generally speaking, the mung, urd, moth, and rice beans are to be compared to the cowpea, while the adsuki is to be contrasted with the common bean.

THE ADSUKI BEAN.

The adsuki bean (*Phaseolus angularis* (Willd.) W. F. Wight; Pl. I) is much cultivated for human food in Japan and Chosen and to a less extent in China and Manchuria, but is apparently unknown in India and elsewhere in Asia. No mention of its cultivation in Europe has been found in agricultural literature.

Next to the soy bean it seems to be the most important legume grown in Japan. In 1910 the respective acreage and production of these two crops in that country were given as follows:

Crop.	Area.	Production.	Yield per acre.
	Acres.	*English quarters.*	*Pounds.*
Adsuki bean	345,634	598,794	969
Soy bean	1,171,438	2,105,964	1,002

From these figures the average yield per acre of adsuki beans is shown to be but little inferior to that of soy beans.

BOTANY AND HISTORY.

The first knowledge of the adsuki, or atsuki, bean to Europeans is the brief description by Kaempfer (1712, fasc. 5, p. 837). Kaempfer's drawing of the plant was later published by Banks (Kaempfer, 1791, pl. 40). This illustration is excellent and unmistakable. On the basis of Kaempfer's description and illustration Willdenow (1801, p. 1051) named the plant *Dolichos angularis*. While the species is clearly and abundantly distinct, it has been confused with related species by most botanists.

No doubt the botanical confusion of the adsuki bean with the mung and the urd is responsible to some extent for the fact that it is so little known.

In most Japanese botanical works the adsuki bean is confused with the mung and therefore called *Phaseolus mungo* or *Phaseolus*

radiatus, from both of which it differs greatly. The adsuki is probably native either in Japan or in Chosen, but the plant is not definitely known in a wild state.

DESCRIPTION.

The adsuki bean is a summer annual, requiring essentially the same conditions of climate as the common bean.

The plants are bushy in habit, growing from 1 to 2½ feet high, according to variety and soil. The earlier varieties are strictly bushy in habit and mostly erect, while the later ones are slightly viny at the tips of the stems and branches, and some of them are decumbent. As with other annual legumes, the later varieties are larger than the early ones. The whole herbage is somewhat hairy, and the leaves persist until the pods are fully mature. The flowers are bright yellow, 6 to 12 in a cluster.

The varieties are very numerous, at least 60 distinct sorts having been tested at Arlington farm, and among these as strays or, more likely, natural hybrids nearly as many others have been detected.

The varieties are distinguished mainly by the period of maturity and the color of the pods and seeds.

At Arlington farm the earliest varieties are fully mature in three months, while the latest require five months.

The pods are straw colored in most varieties, brown in a few, and blackish in a considerable number. In size the pods vary with the seeds, the largest pods being 5 inches long, the smallest 2.5 inches.

Each pod bears normally 8 to 10 seeds. The pods do not shatter readily, but as they are thin the beans may germinate in the pods in long-continued wet weather.

The seeds are subcylindric or but slightly compressed, subtruncate at the ends, and but slightly longer than broad. The following colors occur in the order of their frequency: Maroon, straw to nearly white, gray (really black speckled on a greenish yellow ground color), maroon and straw, black, brown, blue-black, and straw.

The embryo in all cases is nearly white and brittle in consistency.

The adsuki bean is self-fertile, pods setting perfectly where the flowers are bagged. It forms natural hybrids readily, more so apparently than any other related species. In a number of cases the seed of a single plant grown in a row produced diverse progeny. Thus 80 plants were grown from the seed of a plant of S. P. I. No. 19988, which had blackish pods and brown seeds. Of these 80 plants 16 had maroon seeds, 8 with straw-colored and 8 with blackish pods; 53 had brown seeds, 17 with straw-colored and 36 with blackish pods; and 11 had buff seeds, 4 with brown and 7 with blackish pods. It is probably due to this ease of hybridizing that the varieties of adsuki beans are so numerous, and where they are grown near together new sorts will constantly appear.

YIELDS.

No attempt has been made to secure hay from adsuki beans, as it has been evident that none of them could compete with either cowpeas or soy beans for that purpose.

As seed producers, however, they are not only prolific, but ripen evenly and do not shatter readily. Under Arlington farm conditions only the soy bean has given larger yields of seed. (See Table I.)

TABLE I.— *Yields of seed of adsuki beans at Arlington farm, Virginia.*

S. P. I. Serial No.	Calculated yield per acre (bushels).				
	1906	1908 [1]	1909	1912 [2]	1913 [3]
16791	[4] 33.3	22.9	[2] 13.6	23.3	.....
17323	[5] 22.2	21.1	[3] 10.9	.....	.....
17324	[3] 23.3	.....	.....	.....	.....
17324A	[4] 26.6	24.6	[3] 18.1	20.5	19.2
17847	[3] 32.2	26.4	[3] 20.3	28.1	25.3
17851	[3] 26.6	24.8	[3] 22.8	28.6	31.3
19185	.....	.....	.....	22.8	25.0
21082	.....	.....	.....	12.0	22.6
21083	.....	.....	.....	13.1	19.0
25255	.....	.....	[3] 14.6	12.5	10.5
28052	.....	.....	.....	19.1	24.6

[1] Plats of one-eleventh of an acre.
[2] Plats of one-tenth of an acre.
[3] Plats of one-twentieth of an acre.
[4] Rows 4 rods long.
[5] Plats of 0.17 of an acre.

At the North Carolina Agricultural Experiment Station in 1910 the yields per acre secured were as follows: No. 17851, 22.9 bushels; No. 16791, 20.2 bushels; No. 17847, 20.2 bushels.

USE IN JAPAN.

In Japan the adsuki commands a higher price than any other bean, the varieties with maroon-colored seeds being most largely used. In every Japanese city are shops where adsuki beans and adsuki-bean meal are sold, and among the most common cakes and confections are those made wholly or in part from adsuki-bean meal.

Adsuki-bean meal is sometimes prepared simply by grinding the dry beans and then removing the seed coats with sieves. More commonly, however, a wet process is employed. The wet process seems to vary somewhat in different parts of Japan, but consists essentially of four stages:

(1) Boiling the beans until soft, usually after a preliminary soaking.
(2) Crushing the cooked beans.
(3) Removing the skins by forcing the mass through sieves or by putting the bean paste in cold water, when the skins are easily separated.
(4) Drying the bean paste.

The fresh, undried bean paste is called *an* and the dried product *sarashi-an.*

A modification of the above process is to remove the seed coats from the soaked and parboiled beans before they are crushed. In

boiling, the red color of the seed coats dissolves, and on this account the water is sometimes changed once or twice. The final product is somewhat reddish, however. The bean meal in whatever way prepared is eaten in soups and gruels of various kinds, often sweetened. It is also used for making various kinds of cakes and confections.

Other kinds of beans which are cheaper are also used to make *an*, but usually to mix with the more expensive adsuki.

Adsuki beans are also eaten popped like corn, as a coffee substitute, and candied by boiling in sugar, the last product being called *amanatto*. The flour is also used for shampoos and to make facial cream.

The use of beans to make sweetmeats seems to be purely a Japanese invention, as there are no similar foods used by Europeans or Americans. There seems no good reason why food so rich in protein and lacking any objectionable "beany" flavor might not become popular in the United States. No other bean lends itself so well to grinding into meal or flour, as the seeds are hard and brittle.

COMPARISON WITH OTHER SIMILAR LEGUMES.

The most valuable feature of the adsuki bean lies in its large yield of seed, which under Arlington farm conditions is excelled only by the soy bean. These beans are exceedingly popular as food among the Japanese and Koreans. Owing to their texture they are easily ground into meal or flour and for such purposes are far superior to any other bean. The flavor, too, is very delicate, lacking any objectionable taste. The green pods quickly become fibrous, and therefore they are not desirable as snap beans.

As forage plants the adsuki beans can not compete with the cowpea and the soy bean, as their initial growth is slow and their total yield of herbage inferior. In the South they are subject both to wilt (*Fusarium* sp.) and to root-knot caused by the nematode *Heterodera radicicola*. Neither of these diseases has, however, caused any serious destruction of the plants.

PREVIOUS INTRODUCTIONS.

Among the seeds brought back from Japan by the Perry expedition in 1854 was a "red-seeded bean." (Browne, 1855, p. XV.) The identity of this bean has never been definitely determined, but it was doubtless the most common form of adsuki bean.

Two varieties of the adsuki bean were tested at the Kansas Agricultural Experiment Station in 1891 by Prof. C. C. Georgeson (1891, p. 237). Both of these had red seeds, one having the pods "white," the other "black." The white-podded variety yielded 16.3 bushels per acre; the black-podded, 8.7 bushels. In thrashing, the beans were found to crack easily, and so they were flailed. The beans were tested only as human food. "These beans have been sub-

mitted to several housekeepers for trial, who all, with two exceptions, give them most favorable recommendations." The professor of household economy, in a letter to Prof. Georgeson, praised the beans highly both for use in soups and baked.

Two varieties of the adsuki bean were grown at the Rhode Island Agricultural Experiment Station in 1893 and 1894, and yields both of forage and seed based on row tests were recorded. These two varieties were later obtained from the Rhode Island station and given S. P. I. numbers 17315 and 17317.

The North Carolina Agricultural Experiment Station (McCarthy and Emery, 1894, p. 143) gives a very brief report on two varieties of Japanese beans which are unquestionably the adsuki bean. No recommendations are made beyond stating that the beans are for table use only and not for forage.

The following notes on adsuki beans imported by the Office of Foreign Seed and Plant Introduction or obtained from other sources have been assembled for convenient reference. The S. P. I. number is shown in every case.

S. P. I. No.

226. A maroon-seeded variety from North China, March, 1898, under the name "wei-tou (vay-do)." No cultural notes.

494. From Amur Province, Siberia, March, 1898, imported there from China and called "wei-tou (vay-do)." No cultural notes.

5072. From Wahiawa, Oahu, May, 1900, where introduced from China. A maroon-seeded variety. No cultural notes.

6318. From Tokyo, Japan, April, 1901, under the name "muroran." Stocks of seed grown from this were also numbered 8488 and 17316, and it has been sold by seedsmen under the name "Japanese muroran bean." Plants erect, 20 to 24 inches high, maturing at Arlington farm in about 100 days; pods straw colored; seeds maroon.

6417. See No. 17323.

6418. See No. 17324.

8487. Progeny of No. 6417. See No. 17323.

8488. Progeny of No. 6318.

9419. Grown from No. 6417. See No. 17323.

10523. See No. 17315.

13384. Found mixed with soy beans No. 6558 from Hankow, China, May, 1901. Plants erect, 2 to 3 feet high, late, only half the pods maturing at Arlington farm in 140 days; pods 3½ to 4 inches long, straw colored; seeds orange yellow.

13385. From the same source as No. 13384. In habit and maturity like No. 13384; pods straw colored; seeds pale greenish.

13386. From the same source as No. 13384. Plants erect, 16 to 24 inches high; late, about half the pods maturing at Arlington farm in 130 days; pods straw colored; seeds straw colored.

13387. From the same source as No. 13384. Plants erect, 30 inches high, the rows 24 inches broad; only about 30 per cent were mature on October 29, 1912, at Arlington farm, 151 days after planting; pods straw colored, 4 inches long; seeds straw colored.

13388. From the same source as No. 13384. This seems identical in every respect with No. 13386.

S. P. I. No.

13389. From the same source as No. 13384. Late, vigorous, not as large as No. 13386, only a few pods ripening at Arlington farm in favorable seasons; seeds greenish yellow.

13390. From the same source as No. 13384. Seeds greenish yellow. Much like No. 13386.

13391. From the Rhode Island Agricultural Experiment Station, 1903. Plants erect, 20 to 24 inches high, maturing in about 100 days at Arlington farm; pods straw colored; seeds maroon.

13392. See No. 17318.

13393. See No. 17317.

13405. Mixed with No. 6564 from Ichang, China, 1901. Plants erect, 30 inches high; very late, only a few pods maturing at Arlington farm in 140 days; pods straw colored, 3 to 3¾ inches long; seeds straw colored. Apparently but little different from No. 13386.

16791. From Hangchow, China, December, 1905, under the name "tzŭ-tou." Plants erect, 16 to 24 inches high, maturing at Arlington farm in about 120 days; pods blackish, 2½ to 3½ inches long; seeds buff speckled and saddled with black.

17287. Grown from a single stray plant found at Arlington farm in 1905. It proves to be identical in all respects with No. 17317.

17315. Progeny of No. 10523, received from the Rhode Island Agricultural Experiment Station, March, 1904. Plants erect, 12 to 18 inches high, maturing at Arlington farm in about 110 days; pods straw colored, 3¾ inches long; seeds maroon.

17316. Progeny of No. 6318.

17317. Progeny of No. 13393, secured from the Rhode Island Agricultural Experiment Station in 1903. Plants erect, 12 to 16 inches high, all maturing at Arlington farm in about 130 days; pods straw colored, 3 to 3¾ inches long; seeds buff, coarsely sprinkled with black.

17317A. A black-seeded variety found mixed with No. 17317 in 1909 and identical with No. 20007A. The pods are brownish or sometimes dark purple, 3¾ inches long. It is later than No. 17317.

17318. Progeny of No. 13392. Identical with No. 17317.

17319. Progeny of No. 13391, from the Rhode Island Agricultural Experiment Station. This proved to be identical with No. 17315.

17320. Progeny of No. 13405.

17321. Progeny of No. 13386.

17322. Progeny of No. 13384.

17323. Progeny of No. 6417, from Pyeng Yang, Chosen (Korea), May, 1901. Various lots of seed grown from No. 6417 were numbered 8487, 9419, and 17325, but all are identical. Plants erect, 14 to 16 inches high, maturing at Arlington farm in about 140 days; pods straw colored, 3 to 4 inches long; seeds straw colored. This variety is very similar to No. 20402.

17324. Progeny of No. 6418 from Pyeng Yang, Chosen (Korea), May, 1901. Plants erect, prolific, 15 to 22 inches high, maturing at Arlington farm in 140 days; pods straw colored, 4 inches long; seeds buff, speckled with black.

17324A. Selected from a single plant found with No. 17324 in 1905 and has bred perfectly true. Plants somewhat sprawling, 20 to 24 inches high, maturing at Arlington farm in about 130 days; pods straw colored, 3½ to 4½ inches long; seeds buff, blotched with black over half or more of the surface.

17325. Progeny of No. 8487. See No. 17323.

17847. From Changli, China, October, 1905. Plants erect, 16 to 22 inches high, maturing at Arlington farm in about 130 days; pods straw colored, 3¼ to 3½ inches long; seeds straw colored. This is one of the very best varieties in habit and seed yield.

S. P. I. No.

17851. From Tientsin, China, November, 1905. "This variety is used as general food and to make confectionery. The beans are boiled, made into a pulp, and with sugar are baked in small cakes." (Meyer.) Plants erect, 16 to 24 inches high, maturing at Arlington farm in about 130 days; pods straw colored; seeds maroon. One of the very best varieties.

18618. From Shanghai, China, February, 1906. Plants erect, 16 to 18 inches high, about half the pods maturing at Arlington farm in 150 days; pods 3½ inches long; seeds brick red.

19185. From Newchwang, Manchuria, August, 1906. Plants erect, 12 to 24 inches high, maturing at Arlington farm in 120 days; pods straw colored on most plants, brown on about one-fifth, 3 to 4 inches long; seeds straw colored.

19468. From Hoijo (near Kobe), Japan, November, 1906. Plants erect, 16 to 20 inches high, maturing at Arlington farm in about 120 days; pods blackish; seeds maroon.

19988. From Yokohama, Japan, March, 1907. Identical in all respects with No. 19468.

19989. From Yokohama, Japan, March, 1907. Identical in all respects with No. 19468.

20007. From Shi-wa-nanan, Chosen (Korea), July, 1906. "Grows at high altitudes on very poor soils. Used for food, being boiled together with rice and millet." (Meyer.) Plants erect, 18 to 20 inches high, maturing at Arlington farm in about 140 days; pods straw colored, 3¾ inches long; seeds buff, half or more of the surface saddled and blotched with black.

20008. From near Musan, Chosen (Korea), September, 1906. Plants erect, 24 to 26 inches high, maturing at Arlington farm in about 130 days. Two slightly different varieties mixed, one having the pods straw colored, the other brownish; seeds maroon.

20009. From the same source as No. 20008. Plants suberect, 18 to 20 inches high, maturing at Arlington farm in about 140 days; pods brownish, 3 to 4 inches long; seeds buff.

20010. From the same source as No. 20007. In habit and life period almost identical with No. 20009; pods brownish; seeds buff, thickly speckled with black.

20402. From Khabarovsk, Siberia, November, 1906. Plants erect, 16 to 24 inches high, maturing at Arlington farm in about 130 days; pods straw colored, 3 to 3½ inches long; seeds straw colored.

20403. From the same source as No. 20402. Habit and life period quite the same as No. 20402; holds leaves well; pods brownish, 3 to 3½ inches long; seeds buff, thickly speckled with black.

20404. From the same source as No. 20402. Plants erect, about 16 inches high, maturing at Arlington farm in about 130 days; pods straw colored, 3 inches long; seeds maroon. In 1909 this lot seemed to be practically identical with Nos. 20008 and 21083.

20703. From southern Usuri, Siberia, March, 1907, where it is called "wei-tou (wei-do)." Grown only in 1907, maturing at Arlington farm in about 130 days; pods dark colored; seeds buff, thickly speckled with black.

20894. From Kobe, Japan, March, 1907. Plants erect, 18 to 20 inches high, maturing at Arlington farm in about 120 days; apparently a mixture of three kinds, one with dark brownish pods; all maroon seeds.

21081. From Tiehling, Manchuria, January, 1907. Chinese name "pei-hsiao-tou (pei-sha-toa)." This seems indistinguishable from No. 20402 in habit, life period, and seed characters.

21082. From the same source as No. 21081. Plants erect, 18 inches high, and broad, maturing at Arlington farm in 100 days in 1912; pods straw colored, 3 inches long; seeds maroon. In 1909 this variety appeared quite identical with No. 20402.

S. P. I. No.

21083. From the same source as No. 21081. Chinese name "hong-hsiao-tou (hong-sha-tou)." Plants erect, 16 inches high, maturing at Arlington farm in about 100 days; pods straw colored, 3 to 4 inches long; seeds maroon.

21084. From same source as No. 21081. Chinese name "hua-hsiao-tou (gwa-sho-toa)." Plants erect, 14 to 16 inches high, maturing at Arlington farm in about 120 days; pods straw colored, 3½ to 4½ inches long; seeds buff, half or more of the surface saddled and blotched with maroon.

21084A. Mixed with No. 21084. Plants erect, 20 to 22 inches high, maturing at Arlington farm in about 130 days; pods straw colored; seeds brown.

21824. From Hokushu (Hokkaido), Japan, January, 1908. This variety proved to be very similar to No. 19468 in all respects.

22310. From Shanghai, China, March, 1908. A very late variety which failed to mature any seeds at Arlington farm in 1908; pods straw colored, 4 inches long; seeds maroon.

22383. From Canton, China, March, 1908. Plants erect, the row 24 inches high, 30 inches broad, very late, only a few pods maturing at Arlington farm in 1908 and 1912 in 150 days; pods straw colored; seeds maroon.

22410. From Hongkong, China, March, 1908. Plants erect, 24 to 26 inches high, maturing at Arlington farm in about 125 days; pods straw colored; seeds maroon.

22508. From Yokohama, Japan, March, 1908. This proved to be identical with No. 21824.

22509. From Yokohama, Japan, March, 1908. In 1909, the only year grown, this could not be distinguished from No. 20402.

23210. From Tangsi, China, July, 1908. Plants erect, 24 to 30 inches high, a very few pods maturing at Arlington farm in 1909 in 150 days; pods straw colored; seeds maroon.

23210A. Seeds buff, speckled with black. Plants from seeds mixed with No. 23210 resembled that variety very closely; but none of them matured seed in 1909 at Arlington farm.

23210B. Seeds maroon, marbled with black. Plants from seeds mixed with No. 23210, resembled that variety very closely; but none of them matured seed in 1909 at Arlington farm.

23210C. Seeds straw colored. Plants from seeds mixed with No. 23210 resembled that variety very closely; but none of them matured seed in 1909 at Arlington farm.

23301. From Hupehko, Chihli, China, December, 1907. "Used as a vegetable when sprouted; also pounded up with sugar and used in small cakes as a stuffing. Chinese name 'hei-hsiao-tou' (chao-shau-doh). Is able to grow on rather sandy and on alkaline land." (Meyer.) No field notes.

23304. From Peking, Chihli, China, February, 1908. Plants erect, 24 inches high, maturing at Arlington farm in about 130 days; pods straw colored, 3 inches long; seeds maroon. Very similar to Nos. 17851 and 22410.

25139. From Soochow, China, March, 1909. Plants erect, 12 to 14 inches high, half of the pods maturing at Arlington farm in 150 days; pods blackish, 4 to 5 inches long; seeds maroon.

25140. From the same source as No. 25139. Plants erect, 12 to 14 inches high, only a few pods maturing at Arlington farm in 1909 in 150 days; pods straw colored; seeds straw colored.

25141. From the same source as No. 25139. Plants erect, 24 to 30 inches high, a few pods maturing at Arlington farm in 1909 in 150 days; pods straw colored, 3½ to 4½ inches long; seeds buff, thickly speckled with black.

S. P. I. No.

25255. From the Botanical Gardens, Tokyo, Japan, 1907. Plants erect, 24 inches high, maturing at Arlington farm in about 130 days; pods straw colored; seeds nearly white. This variety has paler seeds than any other. It is of excellent habit and one of the most prolific varieties.

25916. From Hangchow, China, August, 1909. Plants suberect, spreading, the row making a mass 30 inches high and broad, only a few pods maturing at Arlington farm in 150 days; pods blackish; seeds maroon.

28052. From Mukden, Manchuria, June, 1910. "Chinese name 'hung-chiang-tou.' Commonly grown in central Manchuria for human food. The beans are sometimes cooked green, but more commonly dried and boiled with millet or kaoliang." (Parker.) Plants erect, 20 to 22 inches high, maturing at Arlington farm in about 110 days; pods straw colored; seeds maroon.

34416. From Cabanas, Cuba, October, 1912. Plants erect, 16 inches high, maturing in about 112 days; pods brown, 3½ inches long; seeds buff, marbled and speckled with black.

34643. From Kyoto, Japan, November, 1912. Plants erect, 26 inches high, maturing in about 143 days; pods straw colored, 5 inches long; seeds maroon.

34644. From Kyoto, Japan, November, 1912. Plants erect, 16 inches high, maturing in about 109 days; pods straw colored, 5 inches long; seeds straw colored.

34700. From Shantung Province, China, December, 1912. Plants slender, erect, somewhat viny at tips, 18 inches high, maturing in about 143 days; pods straw colored, 3 inches long; seeds maroon.

34701. From Shantung Province, China, December, 1912. Plants slender, erect, somewhat viny at tips, 20 inches high, maturing in about 143 days; pods straw colored, 3½ inches long; seeds buff, marbled and speckled with black.

34812. From Tokyo, Japan, January, 1913. Plants erect, 20 inches high, maturing in about 102 days; pods dark, 3¾ inches long; seeds maroon.

34813. From Tokyo, Japan, January, 1913. Plants erect, 30 inches high, the first pods maturing in about 135 days; pods dark, 3½ to 4½ inches long; seeds greenish buff.

34814. From Tokyo, Japan, January, 1913. Plants erect, 20 inches high, maturing in about 109 days; pods straw colored, 4 inches long; seeds maroon.

34815. From Tokyo, Japan, 1913. Plants erect, 28 inches high, the first pods maturing in about 143 days; pods straw colored; seeds maroon.

34816. From Tokyo, Japan, January, 1913. Plants erect, 26 inches high, the first pods maturing in about 135 days; pods dark colored, 4 to 4½ inches long; seeds maroon, marbled and speckled with black.

34948. From Sapporo, Japan, March, 1913. Plants slender, erect, somewhat viny at tips, 18 inches high, maturing in about 102 days; pods dark, 4 inches long; seeds maroon.

34949. From Sapporo, Japan, March, 1913. Plants erect, 18 inches high, maturing in about 102 days; pods dark, 3¾ inches long; seeds maroon; leaflets narrow, strongly 3 lobed at base.

34950. From Sapporo, Japan, March, 1913. Plants erect, 12 inches high, maturing in about 102 days; pods brown, 3½ inches long; seeds maroon.

34951. From Sapporo, Japan, March, 1913. Plants erect, 20 inches high, maturing in about 102 days; pods dark, 4 inches long; seeds maroon.

34952. From Sapporo, Japan, March, 1913. Plants erect, 18 inches high, maturing in about 102 days; pods straw colored, 4 inches long; seeds maroon.

34953. From Sapporo, Japan, March, 1913. Plants erect, 12 inches high, maturing in about 102 days; pods straw colored, 3½ inches long; seeds straw colored.

S. P. I. No.

34954. From Sapporo, Japan, March, 1913. Plants erect, 18 inches high, maturing in about 112 days; pods straw colored, 3½ inches long; seeds buff.

34955. From Sapporo, Japan, March, 1913. Plants erect, 18 inches high, maturing in about 105 days; pods straw colored, 3¾ inches long; seeds buff.

34956. From Sapporo, Japan, March, 1913. Plants erect, 20 inches high, maturing in about 105 days; pods dark, 4 inches long; seeds buff.

34957. From Sapporo, Japan, March, 1913. Plants erect, 24 inches high, maturing in about 112 days; pods dark, 3¾ inches long; seeds greenish.

34958. From Sapporo, Japan, March, 1913. Plants erect, 22 inches high, maturing in about 112 days; pods straw colored, 4 inches long; seeds maroon, marbled and speckled with black.

34959. From Sapporo, Japan, March, 1913. Plants erect, 20 inches high, maturing in about 105 days; pods straw colored, 3½ inches long; seeds maroon, marbled and speckled with black.

34960. From Sapporo, Japan, March, 1913. Plants erect, 12 inches high, maturing in about 100 days; pods brown, 3½ inches long; seeds black.

34961. From Sapporo, Japan, March, 1913. Plants erect, 14 inches high, maturing in about 100 days; pods brown, 3½ inches long; seeds black.

34962. From Sapporo, Japan, March, 1913. Plants erect, 20 inches high, maturing in about 112 days; pods straw colored, 3½ inches long; seeds buff, marbled and speckled with black.

34963. From Sapporo, Japan, March, 1913. Plants erect, 10 inches high, maturing in about 105 days; pods straw colored, 2½ inches long; seeds buff, half or more of the surface saddled and blotched with maroon.

34964. From Sapporo, Japan, March, 1913. Plants erect, 14 inches high, maturing in about 102 days; pods brown, 3½ inches long; seeds buff, marbled and speckled with black.

34965. From Sapporo, Japan, March, 1913. Plants erect, 16 inches high, maturing in about 116 days; pods brown, 3½ inches long; seeds buff.

34966. From Sapporo, Japan, March, 1913. Plants erect, 18 inches high, maturing in about 100 days; pods dark, 4 inches long; seeds straw colored, saddled and spotted with maroon.

34967. From Sapporo, Japan, March, 1913. Plants erect, 16 inches high, maturing in about 102 days; pods straw colored, 3½ inches long; seeds maroon.

34968. From Sapporo, Japan, March, 1913. Plants erect, 14 inches high, maturing in about 102 days; pods dark, 2½ inches long; seeds maroon.

34969. From Sapporo, Japan, March, 1913. Plants erect, 16 inches high, maturing in about 112 days; pods brown, 3½ inches long; seeds maroon.

35216. From Morioka, Japan, March, 1913. Plants erect, 22 inches high, maturing in about 116 days; pods brown, 4 inches long; seeds maroon.

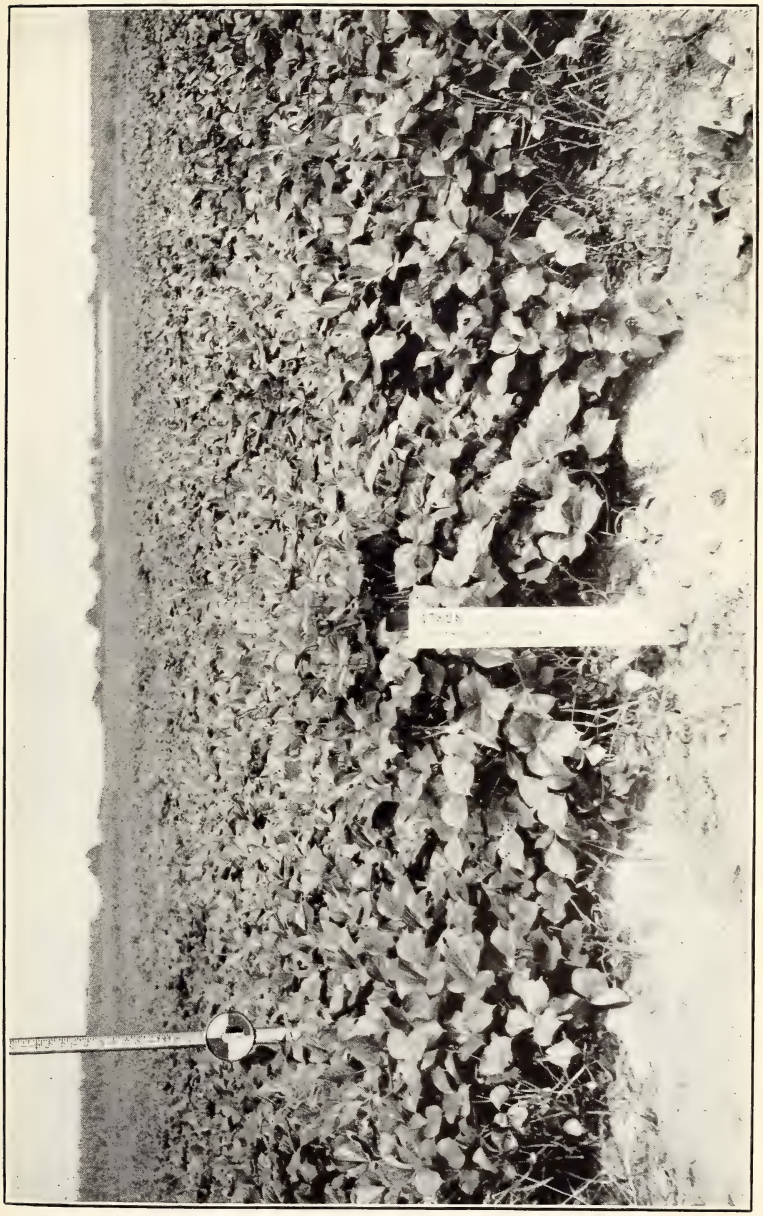
35217. From Morioka, Japan, March, 1913. Plants erect, 12 inches high, maturing in about 143 days; pods brown, 4 inches long; seeds maroon.

35218. From Morioka, Japan, March, 1913. Plants erect, 24 inches high, maturing in about 116 days; pods straw colored, 3½ inches long; seeds buff, marbled and speckled with black.

35219. From Morioka, Japan, March, 1913. Plants erect, 14 inches high, maturing in about 100 days; pods brown, 3½ inches long; seeds black.

35220. From Morioka, Japan, March, 1913. Plants erect, 24 inches high, maturing in about 112 days; pods dark, 3½ inches long; seeds maroon, marbled and speckled with black.

35221. From Morioka, Japan, March, 1913. Plants erect, 22 inches high, maturing in about 116 days; pods brown, 4 inches long; seeds buff.



FIELD OF RICE BEANS IN 36-INCH ROWS AT ARLINGTON FARM, VIRGINIA.

BRANCH WITH FLOWERS OF THE RICE BEAN AND ANOTHER BRANCH SHOWING FULL-GROWN PODS AND LEAF.

THE RICE BEAN.

The rice bean (*Phaseolus calcaratus* Roxb.; Pls. II and III) is cultivated to a limited extent in Japan, China, India, Mauritius, Java, and the Philippines. What is supposed to be the wild original occurs in India. Twenty lots, consisting of nearly as many varieties, have been introduced during the past 11 years. At least one sort was introduced previously and has become sparingly naturalized in Alabama. (See No. 13380.)

The plant is strictly an annual and half twining in habit. Planted in rows the different varieties grow 12 to 30 inches high and produce vining branches 3 to 6 feet long. The leaves closely resemble those of the common bean, but not infrequently are 3 lobed. The flowers are bright yellow, produced in racemes of 10 to 20. The pods are smooth, slender, falcate, straw colored, brownish, or blackish, 3 to 4 inches long, and burst open readily at maturity. Though very productive of seed, the vining habit of the plant, as well as the shattering, makes it difficult to harvest. The flowers are self-fertile, as when bagged at Arlington farm they set pods perfectly.

Like other annual legumes, the later varieties are much larger in growth than the early ones. The late ones are very vigorous in growth and make a thick, dense mass of foliage. Such sorts may prove valuable as cover crops in the South, but unfortunately they are all subject to root-knot. This, together with the shattering of the seed, will always militate against their extensive use.

The varieties differ mainly in their periods of maturity and in the color of the seeds. The latter includes straw colored, brown, maroon, black, and gray marbled.

During the past six years all of the varieties have been grown at Arlington farm, and several have been tested at Chillicothe and San Antonio, Tex.; New Orleans, La.; Agricultural College, Miss.; Auburn, Ala.; Monetta, S. C.; and elsewhere. In the light of present knowledge it is not likely that the rice bean will be used in this country either as a forage crop or as a cover crop, as other plants fill the need better. Nor is it probable that it will be grown for human food, notwithstanding its prolific seeding, as the habit of the plant and the shattering of the seed make it difficult to harvest.

The plant is well adapted to practically the same area as the cowpea and will doubtless attract attention from time to time. Under present conditions it is very doubtful whether this bean can be economically utilized in this country.

In different parts of India various vernacular names are given to this bean, among them Sutri, Sita-mas, Pau maia, Gurush, and Grounsh.

In Japan it is called Tsuru-adsuki; in China, Mu-tsa (Shanghai), Crab-eye or Lazy-man pea (Soochow), and climbing mountain bean (Yachow); in Cuba, where introduced, Little Devil or mambi bean.

BOTANY.

Phaseolus calcaratus was first described by Roxburgh (1832, p. 289) from plants grown in the Botanic Gardens near Calcutta. The seeds were obtained from cultivated plants in Mysore and are described as "dark brownish black," a description which agrees with No. 32640.

Four botanical varieties have been described by Prain (1897, pp. 424–425). *Phaseolus calcaratus major* Prain, from the hills of northern India and Burma, is distinguished by its larger flowers; *P. calcaratus glaber* Prain (*P. glaber* Roxburgh), originally from Mauritius but occurring also in northern India, lacks the hairiness on the leaves and stems; *P. calcaratus rumbaiya* Prain is a variety with short erect or spreading stems, cultivated in the Khasi Hills of Burma under the name Rumbaiya. *P. torosus* Roxburgh, cultivated in Nepal, is said to be very similar and probably a mere form of Rumbaiya, differing only in having the pods torose. The seeds of *P. torosus* are described as short and subcylindric and of a pale cream color. *P. calcaratus gracilis* Prain is a wild form, with slender smooth stems and rather narrow leaflets.

The species is evidently more variable than the varieties introduced during the past 13 years would indicate.

INTRODUCTIONS.

Brief notes and descriptions of the varieties of the rice bean secured mainly by the Office of Foreign Seed and Plant Introduction are here given.

S. P. I. No.

6564. From Ichang, China, 1901. "Grows on the mountains between the Indian corn. Largely takes the place of rice; is also cooked with vegetables before fully dry." Received May, 1901.

This lot of seed contained three varieties as to seed color, which are described under Nos. 13381, 13382, and 13383.

13380. From the Alabama Agricultural Experiment Station, where it has been grown since about 1904. The original seed was secured from Anniston, Ala., where it was said to occur spontaneously. At the Alabama Agricultural Experiment Station it has been called "Alabama bean" and on the station farm volunteers year after year. This variety makes a solid mass 2 feet deep when planted in 3-foot rows. At Arlington farm only a few pods had matured when the plant was killed by frost in 140 days; seeds straw colored.

The same variety has been secured from Mr. Clarendon Davis, of Huntsville, Ala., who writes:

> I believe this will prove a valuable crop. It will take one year more to prove this. The mere fact of the seed remaining sound on ground all winter will prove very valuable for hog pasture, and they will reseed themselves. From what I know of this bean I think it equal to cowpeas for hay, and the fact of its reseeding itself or the seeds remaining on the ground sound until they are eaten would put us in a position to compete with any pea-fed hogs of the West. I now have about 40 or 50 pounds of this seed. My original start was a pod or two. I will plant some in February in wheat. I can not understand why this bean was imported, as it is very rare and only found on the tops of mountains. In fact, I have found only one mountaineer who has ever seen it.

S. P. I. No.

13381. A selection grown from No. 6564. Plants make a dense mass 18 to 24 inches deep, maturing at Arlington farm in about 140 days; seeds straw colored.

13382. A selection from No. 6564. This makes a mass of vine 18 to 24 inches deep. Seeds mature at Arlington farm in about 140 days. In habit, quite like No. 13381; seeds maroon.

13383. A selection grown from No. 6564. In habit and life period quite the same as No. 13380; seeds straw colored, marbled with fine black specks.

17310. Progeny of No. 6564.

17311. Progeny of No. 13380.

17312. Progeny of No. 13383.

17313. Progeny of No. 13381.

17314. Progeny of No. 13382.

17850. From Shanhaikwan, China, 1906. "Used for food, especially in soups." (Meyer.)

The earliest variety tested, maturing at Arlington farm in about 110 days. Vines 14 inches high, hardly covering the ground when in 3-foot rows; pod dark colored, 3 to 4 inches long; seeds straw colored.

18444. From Shanghai, China, 1906. Chinese name "mu-tsa." A vigorous variety, making a mass of vines 18 to 20 inches deep. Too late at Arlington farm, not maturing in 1907, 1908, or 1909, but heavily set with pods when killed by frost in October. A few seeds matured in 1907; seeds maroon.

21291. From Rangoon district, Burma, India, under the name "lobiya," 1907. A very vigorous late variety, the vines 2 to 3 feet high and making a solid mass when planted in rows 3 feet wide. At Arlington farm does not bloom when planted June 1; seeds straw colored. At Auburn, Ala., in 1908, and at Raleigh, N. C., in 1909, its behavior was very similar.

25142. From Soochow, Kiangsu, China, 1909. "From the shape of the seed these are called 'Crab-eye.' They are also the 'Lazy-man' peas, for the reason that they replant themselves. Growth rank; vine bunchy, not very long." Vines in rows make a mass 24 inches deep, 3 feet broad; pods dark colored, 3½ inches long; all mature in about 150 days at Arlington farm; seeds maroon.

25143. From the same source as No. 25142. Exactly like No. 25142 in habit, size, and life period; seeds straw colored.

25523. From the Botanic Gardens, Tokyo, Japan, 1906. Vines in rows make a mass 14 to 18 inches deep, 3 feet wide; pods dark colored, 3 inches long, all maturing at Arlington farm in about 120 days; seeds dark maroon.

30727. From Iloilo, Philippine Islands, April, 1911. Seeds black. No field notes.

30728. From Iloilo, Philippine Islands, April, 1911. Vines make a dense mass 2 feet deep, but not even. Was blooming at Arlington farm in 1912 when killed by frost; seeds straw colored.

30729. From the same source as No. 30728. Identical in growth and appearance to No. 30728; seeds straw colored.

30730. From the same source as No. 30728. At Arlington farm in 1912 this grew exactly like No. 30728; seeds straw colored.

31728. From the market, Canton, China, 1911. Said to be grown locally; seeds maroon; a very vigorous late variety, 2 feet high, blooming properly at Arlington farm, but no pods maturing in 135 days.

32640. From Buitenzorg, Java, November, 1911. Malay name "katjang kajoe aro." Vines making a solid mass 30 inches deep, but blooming at Arlington farm in 1912 when planted June 1; seeds black.

32641. From the same source as the preceding. In habit and behavior identical with No. 32640; seeds brownish.

32642. From the same source as No. 32640. In habit and behavior just like No. 32640; seeds brown, finely marbled with black specks.

S. P. I. No.

32643. From the same source as No. 32640. Growth and maturity just like No. 32640; seeds grayish green, finely marbled with black specks.

32644. From the same source as No. 32640. Indistinguishable in growth from No. 32640; seeds straw colored.

33098. From Cuba, 1912. "Little Devil or mambi bean. An indigenous legume, found growing wild in the woods of Oriente Province, especially in the valley of Guantanamo. A climbing vine of vigorous growth that covers and smothers the tree over which it grows; for this reason the native country people call it 'Little Devil.' It is also called 'mambi,' because it was discovered as edible by the Cuban soldiers during the war of 1868–1878." Very late, not even blooming at Arlington farm in 150 days in 1912 when killed by frost. Vines vigorous, making a solid mass 2 feet deep, but not quite so large as No. 21291; seeds maroon.

01555. From Mr. E. T. Shields, Yachow, China, March, 1911. "This bean is known as climbing mountain bean. It is fed to pigs and not much eaten by the natives." Vines in rows 16 inches high, 30 inches broad, in full bloom at Arlington farm in 120 days, a few pods maturing when killed by frost at the end of October.

THE MUNG BEAN, GREEN GRAM, OR GOLDEN GRAM.

The mung bean (*Phaseolus aureus* Roxb.; Pls. IV and V) is cultivated throughout the southern half of Asia, in the adjacent Malayan Islands, and quite generally through the eastern portions of Africa. It has been introduced into Greece, but otherwise seems not to be cultivated in Europe. In India the plant is of very ancient cultivation, and numerous varieties are found in different parts. The plant is not definitely known in a wild state, but Prain (1897, p. 423) is inclined to think that it is a cultivated derivative of *Phaseolus radiatus* L. (*Phaseolus sublobatus* Roxb.), which grows wild in India. According to Mollison (1901, p. 87) this legume, or pulse, is sixth in importance in the Bombay Presidency, about 200,000 acres being grown each year, mostly mixed with other crops. The seeds are used almost exclusively as human food and the straw is fed to cattle. Duthie and Fuller (1882, p. 37) state that the average yield of seed per acre is 410 pounds. In the Northwestern Provinces and Oudh it is more important than the urd bean, the moth bean, or the cowpea.

In German East Africa it is called *chiroko*, and the same name is used in Portuguese East Africa. In Japan its name is *bundo* or *yayenari*. In Jamaica both the mung and the urd have been introduced by Hindoo laborers. The plant is there called Jerusalem pea and is being used largely as a green-manure crop (Harris, 1913, p. 192).

BOTANY.

There has been great confusion concerning the proper botanical name to apply to the mung. Most of the difficulties in the case have now been cleared up, thanks to the generous assistance accorded by Sir David Prain, director of the Royal Botanic Gardens at Kew. The

CLUSTER OF FULL-GROWN PODS AND LEAF OF THE MUNG BEAN.

FIELD OF MUNG BEANS IN 36-INCH ROWS AT ARLINGTON FARM, VIRGINIA.

mung bean was well known previous to Linnæus's time, having been described by various botanists and well figured by Dillenius (1732, p. 315). Strangely enough Linnæus never gave a binomial name to the mung, through having confused it with the urd and even with the soy bean.

Phaseolus max L. (Linné, 1753, p. 725), which by some botanists has been supposed to refer to the urd, is really the soy bean, as clearly shown by Linnæus's original specimen, which still exists. In naming this plant Linnæus evidently was under the impression that it was the *max* of Arabia described by Avicenna. *Max* is merely a modification of *mash*, under which name the mung is generally known in western Asia. While Linnæus, therefore, intended the name *Phaseolus max* to apply to the mung, the plant he actually described is the soy bean, and the name therefore belongs with the latter plant.

Phaseolus mungo L. (Linné, 1767, p. 101). There is no specimen in the Linnæan herbarium representing this name. Linnæus's description, however, is long and detailed, based on plants grown in the greenhouse at Upsala. From the specific name used, Linnæus evidently thought that his plant was the mung bean, but the description much more clearly accords with the tikari, a form of the urd, as Prain has previously pointed out (1897, p. 422).

Phaseolus radiatus L. (Linné, 1753, p. 725). The original specimen of this plant was grown in the greenhouse at Upsala from seeds obtained from Canton, China. This name has been supposed by nearly all botanists to stand for the mung bean. This is due to the fact that when Linnæus named the plant in 1753 he cited the illustration and description of Dillenius (1732, p. 315, pl. 235, fig. 304). He even took the name *radiatus* from Dillenius's description. Unfortunately, however, Dillenius's plant, which is the mung, is not the same as the plant which Linnæus grew in the garden at Upsala and which forms the type of his *Phaseolus radiatus*. This plant, in the opinion of the botanists at Kew, is the same as that later named *P. sublobatus* Roxburgh. It thus appears that there is no botanical name given by Linnæus that can properly be applied to the mung bean.

Roxburgh in 1832 described and named a number of the species and varieties of Phaseolus grown in India. He changed the application of Linnæus's names in several respects, applying the name *P. mungo* to the green-seeded mung, *P. max* to the black-seeded mung, and *P. radiatus* to the urd. These changed applications of Roxburgh can not be accepted. He also named the golden-seeded mung *P. aureus* (1832, p. 297). This last name is therefore the first published binomial which properly belongs with the mung and which must be accepted as its proper botanical designation, notwithstanding the fact that Roxburgh meant it to apply only to the variety with yellow seeds.

DESCRIPTION.

The mung is an erect or suberect, rather hairy, much-branched plant, growing to a height of 1 to 4 feet, depending on variety. Some sorts twine more or less at the tips of the stems and branches. In a general way the plants are intermediate in habit between the cowpea and the soy bean. The leaves are trifoliate, with rather large, ovate, entire or rarely trilobed leaflets. The flowers are pale yellow, crowded in clusters of 10 to 25. They are fully self-fertile, when bagged setting pods perfectly.

The adaptations of the plant are almost identical with those of the cowpea, and the methods of culture quite the same.

VARIETIES.

The varieties of the mung are numerous, about 20 having been introduced and tested during the past 10 years. They differ in habit, size, period of maturity, color of pods, and size and color of seeds. In habit most varieties are erect or suberect, but in some the tips of the branches are vining. Most kinds grow to a height of about 2 feet, but early sorts are only 1 foot high and very late kinds 3 to 5 feet. The earliest mature their first crop of pods at Arlington farm in about 80 days, while the latest barely ripen seed when killed by frost in 140 days. The pods are black or brownish and vary in length from 2.5 to 4 inches, each containing 10 to 14 seeds. The seeds are globose or oblong, green in most varieties, but in others marbled black and green, yellow, brown, and purple-brown. The weight of 100 seeds ranges from 1.5 to 4.2 grams. The seed coat is marked by innumerable fine wavy ridges, which are sometimes very faint, but apparently never entirely lacking. Sometimes nearly smooth seeds are found in the same pod with others strongly striate. The seeds of *Phaseolus sublobatus* are similarly striate, but those of the urd are smooth.

EARLY INTRODUCTION.

The mung bean was known in the United States previous to 1835, in which year the following article was published (Herbemont, 1835):

CHICKASAW PEA—PEA FODDER.

COLUMBIA, S. C., *May 11, 1835.*

To the Editor of the Farmers' Register:

I send you here enclosed a few of the peas mentioned in your last number [page 752, Vol. II], as a dark bottle green pea, the smallest of the tribe. I prefer it to all others for fodder. Not being a running vine, but rather a bush, it is much more manageable than the common cow pea. My horses prefer it to all other fodder, and when they have it, never leave a bit, eating it all to the oldest and dryest stalk. The best practice in curing pea vines here, is not to let them remain as long in the sun as your correspondent J. M. G. intimates is necessary; but they are cut one day and housed the next, taking care not to let them be packed too close, but kept open by poles or rails being put here and there between them, and kept so for three or four weeks, when the

poles or rails are withdrawn, and the fodder may be then packed as close as convenient. Or a pen is made with rails, is filled up with a few sticks between, and the whole covered with a few boards. The pea herein sent, is called Chickasaw pea; by whom and why it was so called, I do not know; but I sent many years ago one or two gallons of them to the Editor of the American Farmer, in Baltimore, and having forgotten this circumstance, he sent me a few in a letter by the name of Chickasaw pea. I do not think it a native of this country, but have reason to believe it came from the East Indies. This is the plant that would make a most excellent and convenient green dressing for land, were it not as good as it is for fodder. The best way of planting it is in beds two or three feet apart, and ten to fifteen inches in the beds. I usually get one or two gatherings of the pods for seed, and cut them one day, and the next tie them in small bundles and house them as above * * *

N. HERBEMONT.

In 1853 the mung bean was known under the names of Chickasaw pea and Oregon pea, the latter name from a mistaken idea as to its origin. A. B. Rozell (1854), of La Vergne, Tenn., describes it as follows:

The Oregon pea was brought a few years ago from Oregon Territory. Whether it was found wild there, or was obtained from the Indians, I am not prepared to say. I obtained from the State of Mississippi, a year ago last spring, about a teaspoonful of seed, from the product of which I raised last season thirty bushels of peas. Had it not been for the cut-worm, the ravages of which were very great, I would have raised one hundred bushels.

The seed of this plant is very small—less in size than that of the "lady or sugar pea"—and of a pale green color, with a white "hilum," or eye. It grows on a bush from five to six feet high, with five or six large branches near the ground, and they, with the main stalk, put out other branches, until the stalks would make a bunch as large round as a tobacco hogshead, or near it. It grows more like cotton than anything else I know of, only it is much larger, with branches not so horizontal. After leaving the ground a little, all these branches, with those which put out at every joint, bear from four to ten pods in a bunch, with about fifteen peas in a pod, which, as an article of human food, are superior to anything of the kind I ever ate.

The stalks and leaves, which are very large and beautiful, make perhaps the finest hay in the world—stock preferring it to any other—and yield a greater abundance. The hay and pea together are a better and a far cheaper food than can be raised from anything else in the United States, for horses, mules, cattle, sheep, and hogs. I believe I can raise more and better feed for my stock, from one acre of land, than I can from five of anything else I know of. It will grow on land so poor that it would produce little or nothing else; and tolerably poor land is better for it, and will produce more than rich land. This may appear strange to some, but it is nevertheless true. Rich land will produce more stalks, but not so many peas; in this respect it is like cotton. As an improver of the soil, I consider it far superior to clover, or anything known in Tennessee, when fed off on the ground and then ploughed in.

If seed is the object one has in view in raising this plant, let it be sown in drills $4\frac{1}{2}$ feet apart, one or two seeds in a place, one foot asunder along each drill. In the course of the summer, weed and cultivate with the plough or hoe, after the manner of raising bush-beans or Indian corn. For fodder or hay sow them broadcast, and lightly harrow them in, like wheat or other grain.

In short, taking this plant altogether, it is one of the finest and richest productions I ever saw; and I am satisfied in my own mind that it is the greatest acquisition to the farmers of the valley of the Mississippi, and the States adjacent, that has been introduced into this country—guano not excepted—for the last thirty years.

Numerous other articles concerning the Oregon pea occur in the agricultural literature of the period. Most of the reports referring to its cultivation in the Southern States are favorable as regards its value for forage, but there is much variance of opinion concerning the desirability of the beans as human food. The best account is by Ruffin, of Virginia, who in his article on the southern pea (1855, p. 355) includes a description of the plant as follows:

The small green or bush-pea—formerly called by Mr. Herbemont, of South Carolina, the Chickasaw. This kind only, of all enumerated and described here, seems to be a true pea, and therefore is not of the same species with all the other kinds, here termed varieties of the southern pea [cowpea]. Very recently, this pea has been brought before the public under the name of the Oregon pea, and as if a new as well as most wonderful plant. In this way, its real good qualities have been extravagantly exaggerated, and the trumpeters of the false praises have practiced on the public credulity so as to sell the seeds at from $60 to $80 the bushel. Though not reaching half the grade (at least in my culture), claimed for it by the interested eulogists, this pea has some peculiar and excellent qualities. It has been more than 20 years since I obtained the seed, and have cultivated it at several different times. The cessations were caused by neglect to save seed, and the difficulty of saving them, without unusual care.

The seeds are round, and when dry, of a uniform bright pea-green color. They are very small—scarcely as large as duck-shot—and not more than one-third of the size of seed of the early black, buff or other ordinary peas. Of course, fewer seed (by two-thirds or more) will serve for seeding. On the other hand, the young plants are proportionably small, feeble in growth at first, and therefore exposed to be over-powered by weeds, if broad-cast, or to be smothered by tillage, if among corn, or drilled. In later growth, the plant is large and vigorous. It is not a vine (like all kinds of the true southern pea) but an upright-growing shrub, or bush, with large and rough (vilose) leaves, of entirely different appearance from those of all other ordinary varieties. * * * But because of this peculiar manner of growth, this pea is much more easily turned under by the plough than any other kind. This is the great if not the only ground of superiority. The pods are black and short. If they could remain on the stems safely until frost, the gathering would be as easy as of any others, as the pods grow in clusters of from 3 to 6. But a great disadvantage is that if the ripe pods are not gathered before the first rain, they will burst open on drying, and waste their seeds. The ripening also is as late as of any known pea. The main value of this pea must be to plough under as a manure for wheat. Mr. Herbemont, of South Carolina, in a communication long ago published in the Farmers' Register, stated that this plant was valuable for hay. If it will make as good forage and hay as the other vine peas, (and none can be better,) this plant in its manner of growth, would have a peculiar advantage, in being easy to mow by the scythe.

This pea, different from all described as varieties of the great family of southern peas, is not of native origin. It has been supposed to have been derived from India, and more lately and falsely from Oregon. I believe it is from some warm coast of the Mediterranean Sea. The only certain information I have had was that some barrels of the peas were bought at Gosport Navy Yard, at a sale of the old and damaged stores of a frigate returned from a Mediterranean cruise.

[Footnote.] Since writing the above, I have inspected, at the United States Patent Office, some beans and peas, brought from remote countries. Among them was a pea brought from China, which seems to be the same with the kind above described. The Chinese seeds differ from our "Oregon" pea only in being something smaller, and not so plump and round, and being of a more pale and dull green color—as would be if gathered before being quite mature.

The Oregon or Chickasaw pea, as described by early writers, agrees very closely with a sort that has become naturalized in South Carolina in several localities and which was again brought into cultivation by Prof. C. C. Newman, of the South Carolina Agricultural College, in 1905, and hence has been called the "Newman bean." There can be but little doubt that the Newman bean is the same variety that was previously known as the Chickasaw or Oregon pea.

One variety, evidently rather early, as it is spoken of as maturing quickly, was tested in Louisiana (Dodson and Stubbs, 1898, p. 36) previous to 1898, the plant being considered nearly equal to the cowpea in value.

AGRICULTURAL VALUE.

Notwithstanding that the varieties of the mung bean exhibit a wide range of comparative excellence, it is doubtful whether the best will prove a permanent addition to American agriculture. As a field crop the mung is directly comparable to the cowpea and the soy bean, and it has nowhere proved superior to these. The mung is not as vigorous a plant as the cowpea and does not cope very successfully with weeds. As a seed producer it is far inferior to the soy bean, and the seeds are much subject to attack by weevils. The best seed yield that has been obtained was 22.8 bushels per acre, from No. 28053 in 1912 at Arlington farm. At Chillicothe, Tex., the seed yields ranged from 4.1 to 15.2 bushels per acre. The fact, too, that the mung bean did not find a permanent place in our agriculture 60 years ago when it was tested extensively is significant.

At Monetta, S. C., a trial of 20 varieties of mung showed that all were subject both to root-knot caused by the nematode *Heterodera radicicola* and to wilt (*Fusarium* sp.).

At Arlington farm the foliage is much affected each season by a white leaf-spot (*Amerosporium oeconomicum*) and to a greater degree by a red leaf-spot (*Cercospora cruenta*), both of which diseases also affect the cowpea. Some varieties were also considerably injured by a mildew (*Erysiphe polygoni*).

Among the disadvantages of the mung as compared to the cowpea are its slow initial growth, the rather stemmy character of the plant, the tendency of the herbage to turn black in curing, the susceptibility of the plant to root-knot and to wilt, the irregularity of its fruiting, and the shattering character of the pods.

The general conclusion reached from the extensive tests at Arlington farm, as well as at Monetta, S. C., and Biloxi, Miss., taken in connection with the results reached at several southern experiment stations and by various individual cooperators, is that under present economic conditions the mung bean is not to be recommended as a farm crop.

RECENT INTRODUCTIONS.

During the past 10 years the Department of Agriculture has introduced about 50 different lots of mung beans from various sources, which represent about 16 distinct varieties. These have been tested at Arlington farm, Virginia, for periods varying from two to seven years, and also in cooperation with various experiment stations. The following list gives the source of each of these lots, together with brief notes on their agricultural characteristics, based primarily on their behavior at Arlington farm:

S. P. I. No.

224. From North China, 1898, under the name of "lan-tou (lan-dow)." Seeds olive. No cultural notes.

486. From Amur Province, Siberia, where imported from China and called "lan-tou (lan-do)," 1898. Seeds olive. No cultural notes.

1100. From Turkestan, 1898, where it is called "naish" (probably error for "mash"). "The native Sarts use it for food, and the hay makes good winter fodder." (Hansen.) Seeds olive. No reports of trials.

1161. From Kulja, China, 1898. Grown at Arlington farm five seasons; also at Chillicothe and San Antonio, Tex. Stems suberect, 16 to 20 inches high. Eighty per cent of the pods mature in 100 days. Pods black, seeds olive. Apparently identical with this are Nos. 17290, 17303, 22409, 28053, 29445, and 30748.

1385. From Tashkend, Russian Turkestan, 1898. Grown at Arlington farm for six seasons. Plants 18 to 20 inches high, sprawling in habit. At the end of 120 days about 60 per cent of the seed is ripe, but many of the leaves become half dry from leaf-spot. This variety is a poor seeder and much inferior to others in habit. Seeds olive. The variety has also been grown at Chillicothe and Amarillo, Tex., where it grows similarly but not so large.

2873. From Wuchang, China, 1899. "It is often planted among the growing rice, etc." Grown at Arlington farm in 1900, when it proved to be very similar to No. 1385, but a little earlier.

3868. From China, 1899. Grown at Arlington farm for five seasons. Identical with No. 17283.

5071. From Wahiawa, Oahu, Hawaii, 1900. Grown at Arlington farm for six seasons. Identical with No. 6562.

5435. From Calcutta, India, 1900. Grown at Arlington farm, 1905. Planted on June 16 it was only in bud when killed by frost on October 12. Plants 18 to 24 inches high, decumbent, slender stemmed. Seeds yellow, small.

5436. From Calcutta, India, 1900. Seeds globose, small, green marbled with black, distinct from any other lot. No field notes.

5437. From Calcutta, India, 1900. Grown at Arlington farm for three seasons. Plants erect, 12 to 15 inches high, the pods about all ripe in 80 days. Seeds green. An early variety but much subject to leaf-spot.

5518. From Makassar, Celebes, 1900. Grown at Arlington farm one season, 1905. A very late variety, planted May 26 and beginning to bloom September 23, but no pods had matured when killed by frost on October 12. Plants 30 inches high, half erect. Seeds olive.

6224. From Negros, Philippine Islands, 1901, where it is called "mung (mongo)." Seeds yellow. No cultural notes.

6321. From Tokyo, Japan, 1901, under the name "yainari." Grown at Arlington farm for three seasons. Plants 18 to 20 inches high, the bulk of the pods ripening in 90 days. Seeds green. Foliage badly affected by leaf-spot.

6378. Progeny of No. 3868.

S. P. I. No.

6430. From Athens, Greece, 1901, under the name "*Phaseolus viridissimus*." "Their culture in Greece is a restricted one, and the beans are considered a great delicacy." Grown at Arlington farm and elsewhere for five seasons. Plants erect, bushy, 18 to 24 inches high and 15 inches broad, the pods mostly ripe in 100 days. Seeds olive green. Indistinguishable from this are Nos. 5071, 6562, 8540, 8814, 9786, 13397, and 14960.

6562. From China, 1900. As grown for several seasons at Arlington farm this can not be distinguished from No. 6430.

8486. Progeny of No. 6321.

8540. From Poona, India, 1902, where it is called "mung (mug)." This lot is quite identical in growth and maturity to No. 6430.

8585. From Chinkiang, China, 1902. Seeds green. No records of any tests.

8814. From Basra, Arabia, 1902, where called "mash (maash)." "It is employed with rice or boiled and eaten alone." (Fairchild.) As grown for several seasons at Arlington farm this was quite identical with No. 6430.

9786. From Khojend, Russian Turkestan, 1903. Grown at Arlington farm and found not distinguishable from No. 6430.

9889. Progeny of No. 6430.

9890. Progeny of No. 6430.

10284. Progeny of No. 6430.

10329. Progeny of No. 6430.

10407. Progeny of No. 6430.

10527. From Patras, Greece, 1904. In cultural behavior this is exactly like No. 1385. It is not the same variety as No. 6430, also from Greece. Other numbers that are apparently identical with 10527 in all respects are 24813 and 28992.

10610. From Askabad, Turkestan, 1904, where called "mash (masch)." Arlington farm cultures prove this to be the same as No. 6430.

11098. From Abyssinia, 1904. Seeds olive. No cultural notes recorded.

12775. From Prof. C. C. Newman, Calhoun, S. C., 1905. This variety was found by Prof. Newman growing spontaneously near the South Carolina Agricultural Experiment Station and by him brought into cultivation, whence it has been called the Newman bean. As indicated on a previous page, there are excellent reasons to consider this identical with the Chickasaw or Oregon pea first introduced into the United States about 1835. Dr. Haven Metcalf states that he has seen the plant growing spontaneously at four different places in South Carolina. The Newman bean has been grown for seven seasons at Arlington farm and at various other places, besides being abundantly tested by practical farmers. It is a large, late variety, growing perfectly erect to a height of 3 to 3½ feet. At Arlington farm it matures only part of its pods in 130 to 140 days when planted about June 1. The stems are rather too coarse for good hay. Seeds olive green. This is the tallest of all the varieties tested, but becomes fully mature at Arlington only in occasional seasons. No. 30732, from Jolo, P. I., is not distinguishable.

13394. Progeny of No. 6562.

13395. Newman bean. Same source as No. 12775.

13396. From United Provinces, India, 1903. Grown at Arlington farm for three seasons. Plants 2 to 3 feet tall, bushy, late, the bulk of the pods maturing in about 125 days. Seeds olive. Very similar to No. 10527 and probably the same variety.

13397. From Nagpur, India, 1903, under the name "mung (mug)." Grown several seasons at Arlington farm and not to be distinguished from No. 6562.

13398. Found mixed in cowpea seed from Bombay, India, in 1903. The cultures of this show it to be the same as No. 6562.

S. P. I. No.

14960. From Shanghai, China, 1905. Identical with No. 6430.

15926. Progeny of No. 10527.

16210. Progeny of No. 6562.

16211. Progeny of No. 8540.

16323. From Kashgar, Chinese Turkestan, 1905. There called "mash" or "dal." Grown for three seasons at Arlington farm. Plants 18 to 20 inches high, bushy, producing but few pods, which mature in about 120 days. Seeds olive green.

16793. From Hangchow, China, 1905. Seeds olive green. Field notes insufficient.

17096. Progeny of No. 12775.

17283. Progeny of No. 1161.

17284. Progeny of No. 8814.

17285. Progeny of No. 9889 from No. 6430.

17286. Progeny of No. 6430.

17288. Progeny of No. 10407 from No. 6430.

17289. Progeny of No. 6562.

17290. Progeny of No. 13397.

17291. Progeny of No. 13398.

17292. Progeny of No. 13396.

17293. Progeny of No. 10610.

17294. Progeny of No. 9786.

17295. Progeny of No. 8540.

17296. Progeny of No. 6321.

17297. Progeny of No. 5071.

17298. Progeny of No. 5437.

17299. Progeny of No. 10527.

17300. Progeny of No. 12775.

17301. Progeny of No. 13395.

17302. Progeny of No. 6562.

17303. Progeny of No. 3868.

17304. Progeny of No. 1385.

17326. Progeny of No. 3868.

17512. Progeny of No. 10527.

17696. Progeny of No. 10527.

17722. Progeny of No. 10527.

17848. From Changli, China, 1905. Tested at Arlington farm in 1906 and 1907. Plants 18 to 20 inches high. Pods all mature in 130 days. Seeds olive. Probably identical with No. 8814.

20696. From Khokan, Russian Turkestan, 1906. Native name "mash (masch)." This as grown in 1907 was indistinguishable from No. 1385.

20698. From Usuri Province, Siberia, 1906. Chinese name "langо." Seed olive green. Failed to germinate.

21086. From Mukden, Manchuria, 1907. Chinese name "lü-tou (lu-toa)." "Used to make bean-vermicelli, etc." Grown at Arlington farm in 1907 and 1908. Plants bushy, 16 to 18 inches high. Pods begin to mature in 90 days and continue ripening till plant is killed by frost. Seeds olive.

21787. From Calcutta, India, 1908. A large, late variety grown for three seasons at Arlington farm. Plants 24 to 36 inches high, erect. Pods begin to mature in about 100 days, but only half are ripe in 120 days. This variety makes nearly as large a growth as the Newman bean. Seeds olive.

21788. From Calcutta, India, 1908. Grown for two seasons at Arlington farm. Plants sprawling and viny, 12 to 18 inches high, 2 feet broad. Very late. No pods ripe at the end of 120 days and but few in 140 days. Seeds yellow.

S. P. I. No.

22000. From Tientsin, Chihli, China, 1907. Chinese name "huang-lü-tou." In 1909 not distinguishable from No. 17283 in habit and time of maturing, but seeds yellow.

22409. From Hongkong, China, 1908. This proved to be identical with No. 17283, the progeny of No. 1161.

22510. From Yokohama, Japan, 1908, under the name "bundo-mame (runda-mame)."

24570. From Tashkend, Russian Turkestan, where called "mash (masch)," 1908. In 1909 this was found to be identical with Nos. 24813 and 10527.

24813. From Tashkend, near the northern limit of cotton culture in Turkestan, 1908. "It is largely grown in Turkestan under conditions similar to those obtaining in New Mexico and Arizona." (Hansen.) This proved to be identical with No. 10527.

25706. From Poona, India, 1907. Seeds olive. No cultural notes.

26361. From Malkapur, Berar, India, in 1909. This proved to be the same as No. 17283, the progeny of No. 1161.

28053. From Mukden, Manchuria, 1910. The Chinese name is "lü-tou." Grown at Arlington farm for two seasons. Plants 2 feet high, bushy, maturing nearly all their pods in 100 days, but not at all prolific. Seeds olive. Probably the same as No. 17283.

28992. From Kizil-Arvat, Russian Turkestan, 1910. This variety was not distinguishable in 1912 from No. 10527.

28993. From Old Bokhara, Turkestan, 1910. Grown at Arlington farm in 1912. Plants 15 inches high, bushy. Some pods mature in 100 days and about half in 120 days. Seeds yellow.

29445. From Manchuria, 1911, under the name "toza luida." As grown in 1912 at Arlington farm this was not distinguishable from No. 17283, progeny of No. 1161.

30731. From Moro Province, P. I., 1911. Grown at Arlington farm in 1913. Plants very similar to No. 30732. No pods were mature when killed by frost in 140 days. Seeds brownish red.

30732. From Jolo, P. I., 1911. Grown at Arlington farm in 1913. Plants erect, 36 inches high, 24 inches broad. No pods were ripe in 140 days when killed by frost. Seeds green. This variety is apparently identical with the old Chickasaw pea, that is, the Newman bean (No. 12775).

30733. From Iloilo, P. I., 1911. Plants very similar in all respects to No. 30732, but seeds golden. A few pods ripened at Arlington farm in 1913 in 132 days.

30748. From Wulukai, Manchuria, 1911. Chinese name "hsiao-lü-tou (hsiao-liu-tou)." As grown at Arlington farm in 1912 and 1913, not distinguishable from No. 17283.

32363. From Soochow, China, 1911. Grown at Arlington farm in 1913. Plants 3 feet high, 2 feet broad, the branches somewhat viny near the tips; pods few, maturing in 130 days; seeds bright green, nearly smooth. Some of the plants of this lot had the leaflets deeply trilobed.

32608. From Trichinopoly, India, 1911. Grown at Arlington farm in 1913. Plants weak, decumbent, 24 inches high and broad; about half the pods maturing in 140 days. Seeds dark brown.

34776. From Beira, Portuguese East Africa, 1913. On the Zambesi River called "soroko" and in the interior "zoombi." Grown at Arlington farm in 1913. Plants 24 inches high, 30 inches broad, rather sprawling in habit; not prolific; a few pods maturing in 132 days. Seeds olive.

The above 91 lots of seeds represent at least 16 distinct varieties. By the seed characters alone 11 varieties can be distinguished. While there is great difference in value between the varieties, even the best are not as desirable as the cowpea for forage or green manure, and all are inferior to the adsuki bean in seed production.

THE URD, OR BLACK GRAM.

The urd, or black gram (*Phaseolus mungo* L.; Pl. VI), is very similar to the mung and the botany of the two has become much confused. It is easily distinguishable from the mung, however, by the much shorter, stouter, very hairy pods and larger oblong seeds, which vary in color from blackish to olive. The flowers are fully self-fertile. It is cultivated only in India. According to Mollison (1901, p. 88) an area equal to about 250,000 acres is devoted to this crop in the Bombay Presidency, and Duthie and Fuller (1882, p. 39) say that the area in the Northwestern Provinces and Oudh is about 260,000 acres.

In botanical characters the urd is very similar to the mung, but in habit the plants are lower and spreading, the branches usually procumbent. The very hairy stems are never twining in any variety grown at Arlington farm, but a twining variety occurs in India and is distinguished as a crop under the name "tikari."

There is still room for slight doubt regarding the botanical name to be applied to the urd. There is no specimen labeled *Phaseolus mungo* in the Linnæan herbarium. Prain (1897, p. 423) points out, however, that Linnæus's description of *Phaseolus mungo* accords better with the tikari than with any related species, and his judgment, based on a wide knowledge of the Indian species, can hardly be controverted.

From the standpoint of a forage or cover crop the urd is inferior to the mung, as it makes much less herbage. The pods, however, do not shatter so readily, so little of the seed is thus lost. Owing to the low, spreading habit, however, it is necessary to pull the plants in harvesting. The best yield of seed at Arlington farm was 13.6 bushels per acre from No. 17308. The average yield in India was stated to be about 7 bushels per acre in 1912.

The urd is utilized as a green-manure crop in Trinidad under the name of "woolly pyrol," and wherever Hindoo laborers are numerous in the West Indies they cultivate this plant for food.

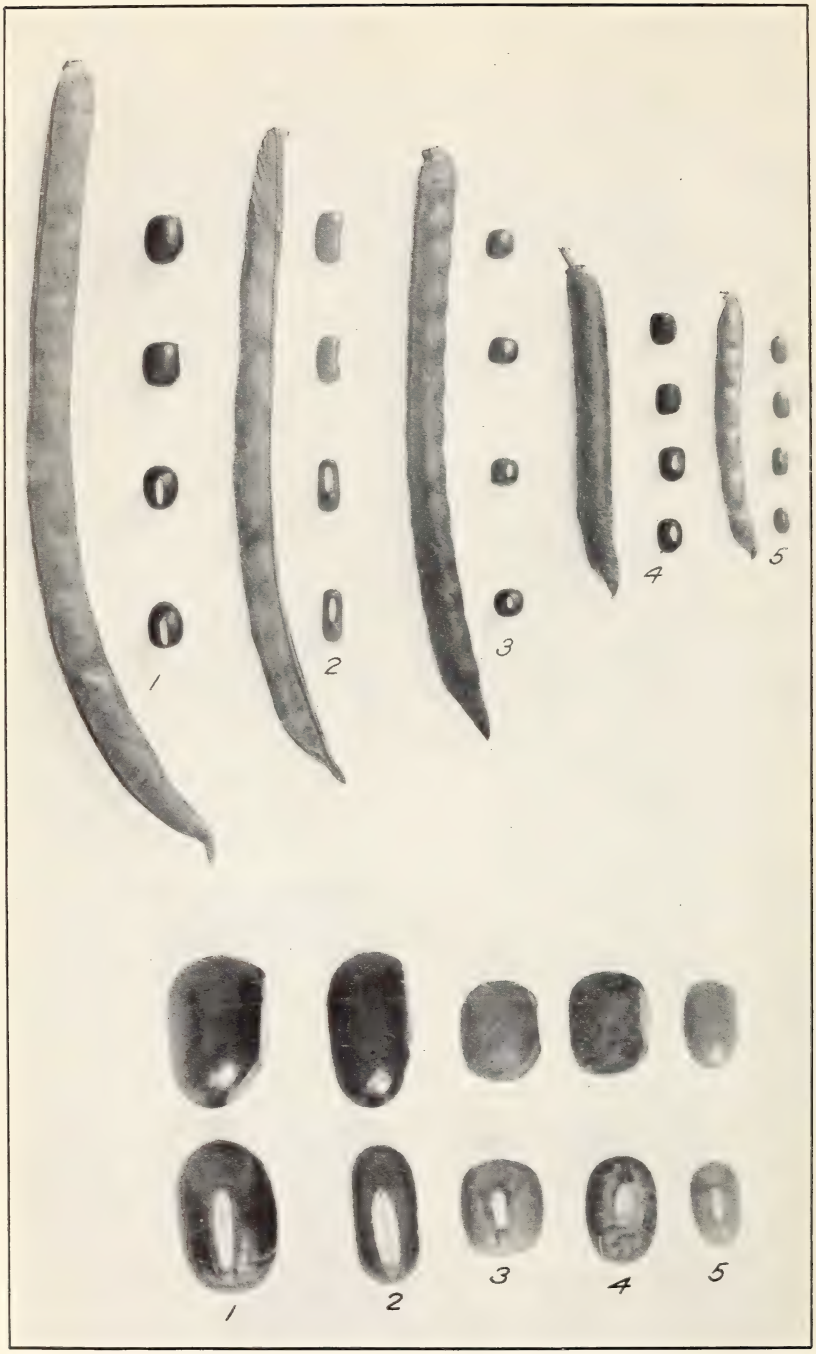
In warm, moist weather the urd is much subject to mildew (*Erysiphe polygoni*). It is also affected by both the leaf-spots that attack the mung and the cowpea.

The habit of the urd is such that it can not be as easily harvested for hay or seed as the mung. It is difficult to see wherein it can compete as a forage crop under American conditions with either the cowpea or the soy bean. As human food the seeds seem far less desirable than other species.

INTRODUCTION.

One variety of the urd, erroneously named *Dolichos cultratus*, was grown in Louisiana in 1898 (Dodson and Stubbs, 1898, p. 37). It was early enough to mature and shatter its seeds by September 1, so that when it was plowed under a good second crop was produced.

FULL-GROWN PODS AND A BRANCH WITH LEAVES AND FLOWERS OF THE URD.



PODS AND SEEDS OF THE (1) ADSUKI, (2) RICE, (3) MUNG, (4) URD, AND (5) MOTH BEANS.

In the lower figure the seeds are magnified 2½ diameters.

Except the trial in Louisiana, there has been found no record of the urd in the United States previous to 1900. Since that year more than 20 lots have been secured, mainly from India, by the Office of Foreign Seed and Plant Introduction. The source of these and their cultural behavior are stated in the following notes:

S. P. I. No.

5438. From the Botanic Gardens, Calcutta, India, in 1900, as "*Phaseolus pilosus.*" Grown but a single season at Arlington farm. A very late variety that did not bloom. Seeds black and gray marbled, very small. Killed by frost October 12. The row formed a mass of herbage 20 inches high and about 3 feet broad.

5439. From the Botanic Gardens, Calcutta, India, in 1900, as "*Phaseolus roxburghii.*" Seeds small, olive. No records of the testing of this variety are preserved.

8541. From Poona, India, 1902, under the native name "udid." Grown at Arlington farm for several seasons. In rows the plants grow to a height of 16 to 18 inches and spread to a width of 2 feet. The majority of the pods ripen in 120 days, but there is a constant tendency to form new pods, so that many are unripe when the plants are killed by frost. Seeds black and gray marbled, dull. At Chillicothe, Tex., this variety produced abundant seed, but too near the ground to harvest with machinery. The seed of this lot germinated 91 per cent in 1906.

13399. From the United Provinces of Agra and Oudh, India, 1903, under the name "katikha." Grown at Arlington farm for three seasons. Plants procumbent, 12 to 18 inches high, about 30 inches wide in the row. Late, only a few pods being mature when killed by frost in 135 days; seeds olive.

13400. From United Provinces of Agra and Oudh, India, 1903, under the name "bhadela." Grown at Arlington farm for five seasons. Plants decumbent, 12 to 20 inches high, not vigorous. Seeds begin to mature by September 1 and 80 per cent are ripe on October 1. Pods dark colored. Seeds olive green.

13401. From United Provinces of Agra and Oudh, India, 1903, under the name "jettira." Grown at Arlington farm in 1905. Not distinguishable from No. 13400.

13402. From Bombay Presidency, India, 1903, under the name "udid." Grown at Arlington farm in 1905. Plants 15 to 18 inches high and 2 to 2½ feet broad. First pods ripen in 100 days. Nearly all are mature in 134 days, when killed by frost. Seeds black, finely marbled with gray. Hardly distinguishable from No. 8541.

13403. From Nagpur, India, 1903, under the name "udid." At Arlington farm this was quite indistinguishable from No. 13402.

16129. From the Louisiana Sugar Experiment Station, Audubon Park, La., in 1905, under the name "*Dolichos formosus.*" Grown at Arlington farm for four seasons. Plants 15 to 20 inches high, about 2 feet broad. Pods mostly mature in 120 days. Seeds black and gray marbled. Hardly to be distinguished from No. 13400.

17134. Progeny of No. 8541.

17305. Progeny of No. 8541.

17306. Progeny of No. 13400.

17307. Progeny of No. 13401.

17308. Progeny of No. 13402.

17309. Progeny of No. 13403.

18310. From Barbados, 1906, where called "woolly pyrol" and much used as a green-manure crop. Grown for four seasons at Arlington farm. A very late, vigorous variety, growing 20 to 24 inches high and 4 feet wide, but not yet blooming when killed by frost after 130 to 150 days. Seeds black and gray marbled.

S. P. I. No.

21708. From Amraoti, India, in 1907, under the name "urid." A late, vigorous variety at Arlington farm growing 20 to 24 inches high and 3 feet broad. At the end of 141 days, when nipped by frost, just beginning to bloom. Seeds black and gray marbled. Apparently the same as No. 21790.

21789. From the Botanic Gardens, Calcutta, India, 1908. Grown at Arlington farm in 1908 and 1912. Plants 12 to 18 inches high, 2 feet broad; 40 per cent of the pods mature in 100 days, 80 per cent in 120 days; pods straw colored; seeds olive.

21790. From the Botanic Gardens, Calcutta, India, in 1908, as "*Phaseolus pilosus.*" Grown at Arlington farm for several seasons. A very sprawling, late variety, the plants 20 to 30 inches high and 3 feet broad. Begins to bloom in about 140 days. At Gainesville, Fla., matured a few pods in 1909, but was badly affected both by wilt and root-knot. Seeds black and gray marbled. Probably the same as 5438.

25516. From Gobindapur, India, 1909. Seeds black and gray marbled. No field notes.

25705. From Poona, India, 1909. Plants 12 inches high, 3 feet broad, blooming in 100 days, but no pods maturing seeds. Seeds black and gray marbled.

26360. From Malkapur, India, 1909. Seeds black and gray marbled. No cultural notes.

28765. From Port of Spain, Trinidad, 1910. "Woolly pyrol." Grown at Arlington farm in 1912. Plants 16 inches high, sprawling, 3½ feet wide. No blossoms when killed by frost. Seeds gray and black marbled.

32607. From Darjiling, India, 1911. Late, not blooming in 1913. Plants large, 30 inches wide, 15 inches high. Seeds shining, black and olive marbled.

34363. Seeds rather small, gray and black marbled.

THE MOTH BEAN.

The moth bean (*Phaseolus aconitifolius* Jacq.; Pl. VII) is cultivated as a crop only in India. It is at once distinguished from any other cultivated bean by the leaflets being divided into narrow lobes. What is doubtless the wild original occurs both in India and Ceylon.

The moth is apparently more important in India than the mung or urd. According to Mollison (1901, p. 86) an area of 300,000 acres is grown in Bombay. Duthie and Fuller (1882, p. 41) give the area in the Northwestern Provinces and Oudh as 211,000 acres. This bean is nearly always planted mixed with other crops.

The plants produce numerous slender, decumbent branches from a short stem, a well-grown plant making a dense mass 18 to 24 inches in diameter and 12 to 15 inches high. In none of the varieties grown is there any tendency of the branches to twine. The seeds are linear, straw colored, nearly smooth; pods 1 to 1.3 inches long, 5 to 7 seeded.

In eight lots of seed secured from India the seeds were the same in all, buff colored, but occasional seeds were marbled with black. These last bred true as to seed color, but the plants were apparently identical with those bearing buff-colored seeds. Occasional plants have leaves with fewer lobes. These are the only variations that have been noted in this bean.

The moth bean has grown very satisfactorily at Arlington farm, Va., and also at Chillicothe, Tex. Owing to its numerous slender stems it produces a very fine quality of hay, but in unfavorable weather for curing the leaves drop off readily. The decumbent habit of the plant also makes it difficult to harvest with a mower. When planted in 3-foot rows at Chillicothe in 1907 for hay production, Nos. 21600 and 8539 averaged 2,680 pounds of hay to the acre, as compared with 3,204 pounds for Whippoorwill cowpeas and 2,380 pounds for Iron cowpeas. At Dalhart, Tex., the moth bean produced in 1909 a yield of 2,500 pounds of hay per acre.

Under the conditions where most fully tested, the moth bean has produced but little seed. During several seasons' trial at Arlington farm very few flowers have formed and but few pods have ripened. At Chillicothe, Tex., the results have been similar, except in 1908, when a small yield of seed was obtained from thin plantings. The reasons for this light seed production are obscure. In India the moth bean yields as much seed as the mung. Duthie and Fuller (1882, p. 41) give the average yield per acre as about 11 bushels.

Even were its seed production higher—and this might be secured by selection—the procumbent habit of the moth bean is such that it is not likely to be grown in preference to the cowpea. At Chillicothe it endured drought better than the cowpea, and this quality of resistance to drought is also noted by writers on Indian agriculture. The difference does not seem sufficient, however, to commend the plant to American agriculture under present conditions.

CHEMICAL ANALYSES.

The results of chemical analyses made by the Bureau of Chemistry of the hay of four of the five species of beans described in this bulletin and of the cowpea for comparison are shown in Table II.

TABLE II.—*Chemical analyses of the hay of the mung, urd, adsuki, and rice beans and of the cowpea.*

Plant.	Water.	Ash.	Ether extract.	Protein.	Crude fiber.	Nitrogen-free extract.
Mung bean (No. 17283), cut when pods were three-fourths grown	7.18	8.40	1.47	10.69	20.57	51.69
Urd bean (No. 17308), cut when pods were half grown	7.66	10.92	1.31	12.72	22.33	45.06
Adsuki bean (No. 17324), cut when pods were three-fourths grown	7.68	9.87	2.03	17.66	23.04	39.72
Rice bean (No. 25523), cut when pods were half grown	6.41	10.15	1.51	11.16	32.88	37.89
Cowpea	10.5	8.9	2.6	14.2	21.2	42.6

Comparative analyses of the seeds of the five oriental species of beans described in this bulletin, with the same data for the kidney bean for comparison, are presented in Table III.

TABLE III.—*Chemical analyses of the seeds of various species of Phaseolus.*

Plant.	Analysis made by—	Water.	Ash.	Crude protein.	Crude fat.	Crude fiber.	Nitrogen-free extract.
Adsuki bean (No. 17847).	Bureau of Chemistry	10.06	3.40	19.22	0.40	4.55	62.37
Adsuki bean	Massachusetts Agricultural Experiment Station.[1]	14.82	3.74	20.23	.75	3.83	56.63
Mung bean	Church[2]	11.4	3.8	23.8	2.0	4.2	54.8
Urd bean	do[2]	10.1	4.4	22.7	2.2	4.8	55.8
Moth bean	do[2]	11.2	3.6	23.8	.6	4.2	56.6
Rice bean	do[3]	10.5	3.9	21.7	.6	5.2	58.1
Kidney bean	Massachusetts Agricultural Experiment Station.[1]	13.0	3.56	19.75	1.22	62.27	

[1] Brooks, 1892. [2] Church, 1886, p. 151–152. [3] Church, 1901, p. 15.

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